

Dr. Thorne Thorne's Report to the Local Government Board on an extensive prevalence of Enteric Fever at Prittlewell, in the Urban Sanitary District of Southend, and on the General Sanitary Circumstances of the District.

GEORGE BUCHANAN,
Medical Department,
June 8th, 1880.

PRITTLEWELL is an ancient village lying about one mile north of Southend, of which it is the mother parish. Until about two years ago it was for sanitary purposes under the jurisdiction of the Rural Sanitary Authority of Rochford; but it was then added to the Urban Sanitary District of Southend, with which it bids fair before long to become one continuous town. The village consists of two principal thoroughfares. One runs from east to west, and is divided into two nearly equal portions known respectively as East Street and West Street. At the point where these two streets join, another street, North Street, starts at right angles to them. It has a northerly direction, and a somewhat rapid slope towards a brook which joins the river Roach at Rochford.

Towards the end of September 1879, a child, Edith S., sickened in Prittlewell, and when it first received medical attendance on the 10th of that month it was found to be suffering from enteric fever. This child, who is nine years old, is believed not to have left the village for at least many weeks prior to her attack, and inquiry made at that date by the Medical Officer of Health, and again by myself after an interval of near five months, failed to elicit any history of previous infection. On the 29th of the same month the mother of this child was attacked with the same disease; two days later two other members of the family, aged 16 years and 12 years respectively, also sickened. About the middle of October another of the children, one aged four years, was attacked, and at intervals varying from two to about four weeks, three others, whose ages were 6 years, 8 years, and 13 years, sickened; there being in all eight attacks in the same family before the middle of December. The house in which this family lived is situated at the western end of the village. The water-supply was at the time derived from the Vicarage well close by. Until the fever broke out no milk was used by the family. The premises were drained into a cesspool, the contents of which soaked through the foundations into the cellar. This cesspool has since been done away with.

On October 7th, a child, Frederick W., aged 8 years, was attacked. The child lived in one of a new group of cottages occupying an isolated position at the western end of the village. The cottage, in common with three other ones, with which it forms a small row, was found to be extremely clean, and to exhibit no source of excremental nuisance. The row is drained into a cesspool, which is situated at some distance from the dwellings; the cesspool is regularly cleansed every four or six weeks, and there is no direct communication between it and the houses. The water-supply is derived from the Vicarage well; and the milk-supply from a source to which no suspicion attaches. In the second week of November another child was attacked in this house.

On the 12th of October the disease appeared in another family also living at the western end of the village, in a yard known as West Cottages, an extremely filthy place, where excrement, drain, and other nuisances were rife, and to some extent still prevail. The person attacked was a young woman, Emily B., aged 16 years, who returned home ill, on the day named, from Southend where she had been in service exactly a fortnight. Three other attacks followed in this house. The girl Emily was ailing when she returned home; she had also spent one day, October 5th, in Prittlewell during the course of the fortnight; and inquiry at the house where she had been living in Southend failed to point to any source of infection there. The water used at her house in Prittlewell was from the Vicarage well, the drainage was into a cesspool, and an offensive

common-privy was situated at about 20 feet from the doors and windows. The milk-supply was from a different source from that used in the house where Frederick W. was attacked.

On the 20th of October a case occurred towards the eastern end of the village, and it was followed within about five or six weeks by two other attacks in the same family; the persons attacked being respectively 3 years, 11 years, and 15 years of age. The house in which the attacks occurred has a closet fitted with a trap and pan, without flushing apparatus, and communicating with a cesspool. The water is derived from "Laslett's well," the surroundings of which are of the filthiest description, and include a sewer ditch at a distance of nine yards full of the most offensive overflowings of the cesspool above referred to. The milk-supply was different from that of the houses previously attacked, and it was evidently in no way associated with the outbreak.

Between this date and the 31st of December one or more fresh cases occurred every week, most of them being in the western portion of the village, including North Street; the total number of attacks up to the end of the year being 35. In January 1880, the cases became much more numerous, 42 cases coming under medical treatment, and the incidence of the disease being specially marked among the inhabitants of North Street. During the month of February the epidemic steadily declined, only 8 cases being heard of.

The total attacks during the course of the epidemic, and concerning which information could be obtained, was 87; but it was ascertained that inclusive of certain mild cases for which no medical aid was sought, the total number of attacks did not fall far, if at all, short of 110, out of a population which I am informed may be estimated at somewhat over 600.

In inquiring as to the cause of the epidemic under consideration the various circumstances to which the inhabitants of Prittlewell were at the time subjected were all carefully investigated. Amongst the points which received special consideration were the following:—

Importation of Infection.—It has already been implied that the first cases which came under notice could not be traced to any prior attack of the same disease. Prittlewell is not a resort of visitors, and no case of enteric fever is known to have occurred there for at least many months prior to September last, and as regards the first three attacks, there is no evidence to show that the disease could have been contracted elsewhere. It is true that in Southend town there had, prior to the commencement of the epidemic, been four deaths from enteric fever. The first occurred on May 17th, but the attack in this case took place in a patient, who, having suffered from enteric fever during the previous month, was, on supposed convalescence, brought to Southend, where a relapse took place with fatal result. The three other deaths took place on 31st August, 1st September, and 4th September respectively. In each of these cases there can I think be but little doubt that the patients received the infection of enteric fever before arriving at Southend. One of them was a lad who, feeling ill, was sent to a hotel in the town for "change of air" and immediately took to his bed. About the same time there were a few non-fatal attacks from the same disease in Southend, and each one of these received careful inquiry, but in no instance could any connexion between them and the Prittlewell epidemic be made out. Indeed the two places are from a sanitary point of view quite distinct; they are situated about a mile apart; they have different water-supplies and distinct methods of drainage; and there appear to be no direct means by which such a disease as enteric fever could spread from one to the other.

Milk-supply.—The milk-supply for the first group of cases was from three different sources having absolutely nothing in common, and it appears quite evident that milk had no influence either in the origin or the spread of the infection.

Means of Sewerage and Drainage.—Nearly the whole of Prittlewell was at the date of the epidemic provided with cesspool drainage, some of the cesspools, and a few house drains, being connected with a pipe drain originally constructed for the purpose of carrying off the road water only. The cesspools are all sunk in a porous soil; some being professedly water-tight, others are obviously not so. In very exceptional instances, however, and these do not include the houses in which the disease appeared, was there any direct

means of communication between the cesspools and drains on the one hand and the interior of the dwellings on the other; and having regard to this fact and to the circumstance that the houses first attacked had absolutely nothing in common as regards means of drainage, I am led to conclude that, bad as is the means of drainage of Prittlewell, it was not the originating cause of the epidemic.

Means of Excrement Disposal.—With the exception of one or two houses with waterclosets, Prittlewell is throughout provided either with common-privies or with closets fitted with trap and pan, but having no flushing apparatus. Both forms of closets communicate with cesspits. These cesspits are in some instances of enormous dimensions and allow of the accumulation of their contents for many years. It is also quite evident from the amount of liquid finding its way into many of them that they admit of free percolation into the surrounding soil. The closets are very generally a source of nuisance, and they doubtless have tended to the diffusion of the enteric fever, a disease the spread of which is so intimately connected with conditions of excremental poisoning. There was, however, no evidence that they had, apart from their influence on the water-supply, been the immediate cause of the first attacks recorded.

Water-supply.—The village of Prittlewell lies upon an extensive bed consisting partly of brick-earth and gravel, but mainly of sand; this bed varies in depth from about 18 feet to somewhat over 40 feet in thickness, and overlies the London Clay. With the exception of the Vicarage well, to which allusion has already been made, all the wells in the village are sunk through this porous bed just into the London Clay, where a small reservoir is formed in which the water is held. The sandy bed is thickest to the south, becoming thinner as the village slopes towards the brook on its northern boundary. From excavations which have been made in various parts of the village and its vicinity it also appears that the surface of the London Clay exhibits beneath the gravel and sand an extensive hollowing out, which runs from the south-west end of the village nearly in a north-easterly direction towards the brook; the centre of the hidden valley thus made passing somewhat diagonally across and including the lower two-thirds of North Street. In the direction of this valley the principal springs flow; these springs being formed by soakage from the surface of the porous sandy and gravelly bed. From this description it will be obvious that, unless the greatest care were exercised in freeing the surface soil in Prittlewell from all sources of contamination, there would be constant risk of pollution to the porous water-bearing bed owing to soakage of filth. Enough has already been said to show how this source of danger has been disregarded, but examination of the circumstances likely to affect the fouling or otherwise of the surface soil in the line of the springs, and especially along the backs of the houses in North Street, affords convincing proof that the danger so arising has been of the most serious character. Indeed, starting from the north-west end of the village and following the line above indicated, cesspools and privy-pits, some of which are 12 feet and 18 feet deep, cowyards and farmyards having no means of drainage except into the surface soil, and drains, some of which receive the overflow of cesspools, and are admittedly of imperfect construction, are found almost everywhere to alternate with the wells.

As the result of my investigation into the cause of the epidemic in Prittlewell, I had, prior to a detailed examination of the circumstances affecting the well-waters, arrived at the conclusion that the disease was due to the use of a polluted water-supply, and the description above given shows the means by which this pollution could have been, and doubtless was, effected. It is also noteworthy that the great stress of the epidemic fell upon the consumers of water from sources lying in West Street and North Street, and that the east end of the village which would appear to be out of the line down which surface soakage of filth would be washed by the springs, almost entirely escaped. It is true that this fouling of the surface soil had for years, if not for generations, been in progress, and yet no such epidemic as the one now under consideration is remembered. Under ordinary circumstances I have very little doubt but that the organic refuse finding its way into the porous bed overlying the London Clay, and having slowly to filter through it vertically to a depth varying from about 40 feet to 50 feet, and horizontally for a

much greater distance along with the springs when these were reached, would be placed under conditions specially favourable to its filtration and to its partial oxidation. The extent, however, to which such a process would take place, must necessarily remain unknown, and hence a water-supply having such a source must doubtless often have been polluted to a greater or less extent, and must be considered as one at all times dangerous to health.

There were, however, special circumstances which, prior to the outbreak, would have tended to an exceptional pollution of the springs supplying the wells. From observations which have been recorded in Essex, it appears that the mean rainfall for the four months of June, July, August, and September, during a period of 17 years prior to 1879, reached 8·38 inches; whereas, during the same months in 1879 it reached 15·55, or in other words it was nearly doubled. Such an exceptional rainfall would, under the special geological circumstances obtaining in Prittlewell, have had the effect of washing down the hidden valley in the London Clay into which the wells are sunk, not only old accumulations of filth, but also unusually large quantities due to recent soakage, and thus the condition of the wells in the autumn of last year was probably at its worst. To the ever varying character of the water, caused by the rapid flow of the springs along the surface of the clay towards the north-west, is probably to be attributed the fact that the use of the contents of the wells has not led to even more disastrous circumstances, for quite apart from the question as to the quantity of organic refuse which at the time of the outbreak found its way into the wells, it must be remembered that when once enteric fever was prevalent at the south-west end of the village, the soakage of filth which was carried in the direction of North Street included the specific poison of that disease.

There is, however, one well in Prittlewell which at first sight ought to have escaped this general pollution, and yet, as the result of my inquiry, it seems impossible to exclude it in dealing with the causes of this outbreak. I refer to the Vicarage well. This well is sunk at the western end of the village through somewhat over 40 feet of surface soil, brick earth, gravel and sand, then to a greater depth of about 380 feet through the London Clay, and to a sufficient depth into the Lower London Tertiaries, to reach the water held up in these strata. The well is lined with brickwork and cement to a depth of some 120 feet, and hence it was at first difficult to account for the apparent part which the use of its contents had played in causing the fever outbreak. But later on, and owing to the continuance of the epidemic, a sample of the water was submitted to chemical analysis, and it was found to be contaminated with sewage. This led to the well being thoroughly examined, and it was then ascertained that at a depth of 40 feet, that is where the superficial sandy bed rests on the London Clay, there was an oozing into the shaft of the well. The water usually derived from this well is soft, but it had been noticed that, on several occasions after long continued rainfall, it had become hard, and this hardness was again observed as the result of the exceptional rainfall of last summer. There can, indeed, be but little doubt that, owing to a gradual filling up of the valley in the London Clay, to which reference has been made, the body of water usually contained in it spread in a westerly direction, and so found its way into the Vicarage well through the defective brickwork. This well was, at the date of my visit, being repaired, with a view to the complete exclusion of all water lying above the London Clay. The proximity of a drain to this well at first led to the impression that soakage of sewage into it might have occurred from some leak in the drain, but subsequent examination of the course of drain and of its surroundings, showed that this was not the case.

Sanitary Measures.—When the first cases of enteric fever occurred in Prittlewell the adoption of certain steps, including the burial of excreta, was urged at the several households affected, by the two medical practitioners who attended the cases. Later on, however, when the disease was on the increase, the gravity of the circumstances was specially brought under the notice of the Sanitary Authority by Mr. E. E. Phillips their Medical Officer of Health, who expressed his opinion that the disease was mainly due to the contamination of the wells owing to defective means of sewerage and excrement disposal. The Authority then determined without further delay to provide means of

sewerage for that end of the village where the epidemic had commenced, and they also forwarded samples of water drawn from several wells, for chemical analysis, and on ascertaining that they were all contaminated, they at once delivered, by means of a water-cart which passed twice daily through the village, a water-supply for domestic purposes, derived from the mains of the Southend Waterworks Company. (For the results of the analysis of these waters, see Appendix.) They at the same time appointed a new Inspector of Nuisances, the former one having combined the duties of that office with those of Surveyor to the Local Board of Health, and they caused a supply of disinfectants, with advice as to their use, to be provided for the village. The new sewer was laid down West Street in November last, and its contents at present empty into an old drain originally laid down North Street for highway purposes. They ultimately reach a depositing tank fitted with filter beds, where the sewage is to a certain extent strained before passing into the brook. The sewers as yet have no special means of ventilation, and the eastern end of the village retains its system of cesspool drainage. The subject of the sewerage of Prittlewell has been under the consideration of the Southend Urban Sanitary Authority ever since the village was added to this district about two years ago, and I am informed that it is intended to proceed with it and make it efficient as soon as possible. The temporary provision of a wholesome water-supply for the inhabitants was one of the most important steps taken by the Sanitary Authority last autumn, and it doubtless tended very materially to limit the extent of the epidemic. Its influence also would have been greater had the Authority felt themselves able at the same time to take measures for closing the polluted wells. The difficulty however, of supplying the inhabitants with a sufficient quantity of water for all household and other purposes by means of water-carts prevented this step from being adopted at the time. They therefore gave public notice to the effect that the well-waters were dangerous to health, and announced that a supply would for domestic purposes be regularly brought to the doors of the inhabitants, an arrangement which still remains in operation.

With regard to the future supply of Prittlewell, it should be stated that the Sanitary Authority during the course of my inspection determined to request the Southend Water Company to lay their mains throughout the village with the least possible delay, and they also decided to take measures for the closing of polluted wells. It is quite possible that the Company may, during the summer months when Southend is full of visitors, find that the adoption of this step will cause some interference to the constancy of the service as regards certain cisterns in the upper floors of some high lying portions of their district, but this drawback will be only a temporary one as the Company are now sinking a new well for the general purposes of their district close to Prittlewell village. This well has already been excavated and lined with brickwork and iron plates to a depth of 360 feet, and is to be bored a further depth of above 500 feet.

SOUTHEND TOWN.

Southend Proper consists of the Old or Lower Town, which lies at a low level along the estuary of the Thames, and of the New or Upper Town, which occupies a much higher level on the cliffs to the west of the old town, and also extends inland. The new town is spreading rapidly, and in an outlying portion of it to the north, known as Porter's Town, large numbers of dwellings for the working classes are being erected, and streets are being laid out which bid fair before long to form a connecting link between Southend and Prittlewell.

In connexion with the inquiry I made as to enteric fever in Prittlewell I found it necessary to make myself generally acquainted with the sanitary circumstances prevailing in the town. The more important of these are as follows:—

Water-supply.—By far the greater portion of Southend and Porter's Town is provided with water from the works of the Southend Waterworks, the supply being derived from a well sunk through the London Clay, the Oldhaven, Woolwich, and Thanet beds, and for 304 feet into the Chalk, the total depth of the well being 908 feet.

The water as delivered by the company is unquestionably a wholesome water ; and the service is a constant one. There are means by which air can be admitted to the mains during any intermission which may occasionally occur during repairs, &c. and the company's regulations as to house services are framed so as to prevent the risk of pollution after the water leaves their mains. In some houses, however, constructed before these regulations came into operation, and amongst these, houses where some cases of enteric fever have occurred, the water for domestic purposes is drawn from cisterns supplying waterclosets. At Porter's Town there are a number of wells sunk through the same porous soil as that obtaining in Prittlewell, and they are not only subject to constant risk of pollution owing to soakage from cesspools, but the contents of some are obviously too foul for use. The mains of the Southend Water Company have recently been carried through the various streets of Porter's Town, and in many instances the water is already laid on to the houses. In the Old Town there are also houses greatly standing in need of the public water service, which though lying close at hand has not yet been made use of.

Sewerage and Drainage.—The system of sewerage and drainage in Southend is as yet incomplete. The town proper is throughout provided with sewers having three outfalls. The sewage from the Upper Town, including what is known as The Hamlet, is conveyed by means of two outfalls into the Swatch, a channel situated about two-thirds of a mile from the foreshore, and containing some 13 feet or 14 feet of water at the lowest state of the tide.

Nearly all the sewers in the Upper Town are unprovided with means of ventilation, and the necessary result is that sewer air makes its way into such houses as have unbroken communication with the sewers. The outfall for the Lower Town sewer also passes on to the foreshore at a considerable distance from land. At its further extremity this outfall sewer is constructed with a "swan neck" bend, the effect of which is to retain sewage in it for a considerable length of its course at all states of the tide. What beneficial object is served by this arrangement I failed to learn, whereas the injury it does, especially where the houses are placed in direct communication with the sewers, is obvious. The Lower Town sewer is ventilated throughout its course by shafts rising to the road level.

A great deal of work has within recent years been effected in connexion with the sewerage of Southend, and much is still in progress. Thus, since the appointment of the present town surveyor, in October 1878, a large number of offensive drains opening on to the foreshore have been abolished in connexion with the construction of a new sea wall and esplanade, and several miles of new sewers provided with proper means of ventilation have been constructed, or are now in process of being completed. During the course of my inspection, it was also determined to provide means of ventilation for all the Upper Town sewers.

Within recent years the Sanitary Authority have not allowed any direct communications to be made with the sewers, and with a view, amongst other things, of dealing with this matter more efficiently they are now proposing to submit a revised code of byelaws as to New Streets and Buildings for the approval of the Local Government Board.

Means of Excrement and Refuse Disposal.—The watercloset system obtains generally throughout Southend, and with regard to it, it is only here necessary to note two principal defects. Some of the waterclosets are built in the body of the houses instead of at an external wall where proper means of ventilation can be procured. This will be obviated as regards new houses by the adoption of the byelaw in the Board's "Model Series" relating to this subject. The other point relates to the absence of any proper means of flushing for closets constructed with a trap and pan and communicating with the sewers. Experience here, as elsewhere, shows that hand flushing does not suffice to keep such closets free from nuisance.

With regard to refuse disposal I have only to note that a ditch lying behind some houses in the Lower Town is improperly made a receptacle for manure and other refuse ; otherwise no defects of scavenging came under notice.

Mortality Statistics.—At the census of 1871, the population of the Prittlewell sub-district, which, so far as the number of inhabitants is concerned nearly corresponds with Southend Town, together with its outlying parts and

and Prittlewell Village was 6,989, but owing to the rapid increase which has taken place in Southend since the date of the last census, as also to the large influx of visitors to which the town is subject, especially during the summer and autumn months, I found it impossible to form any opinion as to the general death-rate, or the death-rate from special causes which has prevailed there during recent years. I, however, subjoin a table giving the total deaths, and certain deaths from specified causes which have taken place both in Southend and in Prittlewell during the past five years, some of the deaths in the new suburbs of Southend being, however, for registration purposes, included in Prittlewell:—

Date.	Locality.	Total Deaths from all causes.	Typhoid or Enteric Fever.	Diarrhœa, Dysentery, &c.	Scarlet Fever.	Diphtheria.	Croup (non-spasmodic).
1875	Southend - - -	65	2	9	2	—	—
	Prittlewell - - -	43	1	3	—	—	—
1876	Southend - - -	76	1	14	3	1	1
	Prittlewell - - -	46	1	2	1	—	—
1877	Southend - - -	58	2	5	—	—	1
	Prittlewell - - -	41	—	4	2	—	—
1878	Southend - - -	80	—	4	1	1	2
	Prittlewell - - -	55	—	1	—	6	3
1879	Southend - - -	93	6	3	1	1	6
	Prittlewell - - -	43	2	1	—	—	1
Totals for the 5 years 1875-79		372	11	35	7	3	10
		228	4	11	3	6	4

Inferences from this table must necessarily be imperfect, but quite apart from enteric fever, which has already been sufficiently considered, it is deserving of note that diarrhœa has at times been the cause of a considerable number of deaths, and that diphtheria, together with non-spasmodic croup, which was doubtless the same disease, was very fatal in 1878 and in 1879. Several houses where the diphtheria had been prevalent were visited, and in Southend Town it became evident that the disease had been associated with conditions favoring the poisoning of air breathed owing to direct connexions existing between the houses and the drains. As regards the prevalence of the same disease in Prittlewell in 1878, the time for investigation as to its cause had, at the date of my inquiry, already long gone by, but the conditions I have described as prevailing in the village are precisely those which elsewhere are found to favour the spread of the disease.

R. THORNE THORNE.

Recommendations.

1°. The Sanitary Authority should see that every house within their district is supplied with a proper water supply. In Southend Town and in Porter's Town, where the existing supply is either deficient or liable to pollution, measures should immediately be taken to have the Company's water laid on. As regards Prittlewell no unavoidable delay should be allowed to occur in securing for the entire village a supply from the same source.

2°. Measures should also be taken under section 70 of the Public Health Act, 1875, to secure the closing of all wells that may become contaminated.

3°. The village of Prittlewell should throughout be provided with efficient means of sewerage, and the existing new sewer should, without delay, be provided with proper means of ventilation.

4°. The efficient ventilation of the sewers in the Southend Upper Town should be effected as speedily as possible, and effectual means should be adopted to prevent the nuisance and danger to health arising from direct communications between the interior of houses and the sewers.

5°. The Sanitary Authority should also procure skilled advice as to the best method of dealing with the outfall sewer at the east end of the Lower Town, so as to obviate as far as possible any needless retention of its contents.

6°. Wherever sewers are provided all cesspools should, after being properly cleansed and filled in, be abolished.

APPENDIX I.

DEAR SIR,

February 5, 1880.

HEREWITH I send you the results of the analysis of the five waters you submitted to me for examination.

My report is the same for them all. They all contain very large quantities of sewage, purified by filtration through porous strata, fairly well in the case of 1 and 3, but imperfectly in Nos. 2, 4, and 5. They, however, are all waters which may at any moment become dangerously polluted, and, I am of opinion, are entirely unfit for drinking purposes.

Nos. 2, 3, 4, and 5 are very hard waters indeed, whilst No. 1 is a moderately soft water.

I advise that all the wells be closed.

Faithfully yours,
C. MEYMOTT TIDY.

3, Mandeville Place, Manchester Square, W.

February 5, 1880.

RESULTS of the ANALYSIS of five samples of WATER received from Mr. PHILLIPS of SOUTHEAD at the LABORATORY of the LONDON HOSPITAL MEDICAL COLLEGE, WHITECHAPEL, LONDON, on the 23rd day of JANUARY 1880, and contained in 10 WINCHESTER QUART BOTTLES duly tied down and labelled as follows :—

The results are stated in grains per imperial gallon of 70,000 grains, the organic carbon and nitrogen being stated in parts per 100,000.

Description.	Total Solid Matter.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Nitric Acid.	Oxygen required to oxidize the Organic Matter.	Organic Carbon.	Organic Nitrogen.	Lime (Ca O).	Magnesia (Mg O).	Sulphuric Anhydride (S O ₂).	Hardness		—
											Before boiling.	After boiling.	
No. 1 well, Vicarage Well -	Grains. 63·25	Grains. 0·000	Grains. 1·020 =	Grains. 4·590	Grains. 0·015	Parts per 100,000. 0·050	0·020	Grains. 4·25	Grains. 1·081	Grains. 5·10	Degrees. 6·0	Degrees. 2·8	Turbid. No odour.
No. 2 do. Warren's Yard -	146·60	0·001	7·740 =	34·83	0·090	0·214	0·064	26·63	4·90	15·65	40·1	20·0	Do.
No. 3 do. Mr. Spendelow -	49·75	0·001	1·650 =	7·425	0·011	0·046	0·028	13·02	2·232	4·93	20·6	15·4	Slightly turbid.
No. 4 do. Parish pump -	104·2	0·003	4·575 =	20·57	0·050	0·201	0·034	21·812	4·647	16·10	27·8	20·0	Do.
No. 5 do. at Fulford's -	43·60	0·002	0·600 =	2·700	0·044	0·211	0·060	12·55	2·053	5·13	17·1	9·5	Do.

C. MEYMOTT TIDY, M.B., M.S., F.C.S.

SOUTHEND WATER.

I BEG to enclose my 1034 of the sample of water forwarded me for analysis, and may content with repeating merely that the examination proves the water to be one of very considerable purity, good and wholesome.

ANALYSIS of WATER drawn from MAIN of SOUTHEND WATERWORKS.

Total Solid Matter.	Ammonia.	Nitrogen as Nitrates and Nitrites.		Nitric Acid.	Oxygen required to oxidize the Organic Matter.	Organic Carbon.	Organic Nitrogen.	Lime (Ca O).	Magnesia (Mg O).	Sulphuric Anhydride. (S O ₃).	Chlorine = Common Salt.	Hardness	
		Before boiling.	After boiling.										
Grains.	Grains.	Grains.	Grains.	Grains.	Parts per 100,000.	Grains.	Grains.	Grains.	Grains.	Grains.			
64.25	0.001	0.090 = 0.405		0.015	0.061	0.020	1.47	0.504	4.47	22.75 = 37.28	1.6°	0.40°	

It contains 1.7 grains per gallon of silica. The residue was exceedingly alkaline. It was very slightly turbid when seen through a stratum two feet in thickness.

C. MEYMOTT TIDY, M.B.

March 2, 1880.